6.1.5 DNA structure

AQA GCSE Biology (Higher)
Question and answer notes

For more resources, visit www.mooramo.com

How to use these notes

These notes cover everything you need to know for this part of the specification. They have been written in question-answer format to make them easier for you to study from.

In order to study successfully, I recommend you do the following for each question and answer:

- Read it carefully and make sure you **understand** it.
- **Memorise** the answer.
- **Practice** applying your understanding to past exam questions.

A good way to memorise information is to use **retrieval practice**. This is when you practise retrieving information from your memory. You could do this by making a flashcard for each question with the question on one side and the answer on the other. Or you could use a flashcard app. Alternatively, use a sheet of paper to cover up the answer so you can only see the question. Try to answer the question and then check how you did.

You should practise retrieving each answer from your memory until you can do it perfectly. Even once you can retrieve the answer perfectly, your ability to retrieve it will probably fade as time passes without practising. Therefore you will need to keep going back to the questions that you have previously mastered and practising them again. However, each time you re-learn the answer, the memory will be stronger and will last longer than the time before.

What is DNA made of?
DNA is made of nucleotides.

What is the structure of a nucleotide?
A nucleotide is made up of a sugar with a phosphate group and a base bonded to it.

What are the four bases found in DNA nucleotides (first letters only)?
The four bases found in DNA nucleotides are A, T, G and C.

What is the structure of a strand of DNA?
A strand of DNA is made up of many nucleotides bonded together. The phosphate group of one nucleotide bonds to the sugar of the next to form a sugar-phosphate backbone. The bases stick off to the side of the sugar-phosphate backbone.

What is the structure of double-stranded DNA?
Double stranded DNA consists of two DNA strands wound around each other to form a structure called a double-helix. The bases on the two strands pair up with each other.

What are the DNA base pairing rules?
The DNA base pairing rules are:

- A and T always pair up with each other
- G and C always pair up with each other.

Why is DNA described as a polymer?
A polymer is a molecule which is made of many smaller molecules bonded together. DNA is described as a polymer because it is made of many nucleotides bonded together.

What is coding DNA?
Coding DNA is the genes. It is called coding DNA because genes code for proteins - in other words, each gene contains the instructions for making a protein.

What does it mean for a gene to be expressed?
We say that a gene is being expressed when the gene is being used to make the protein that it codes for.

How does a gene code for a protein?
The sequence of bases within a gene determines the sequence of amino acids in the protein that it codes for. Each three bases in the sequence codes for one amino acid.

How is a protein made?
The process of making a protein is as follows:

- First, a copy of the gene is made. This copy will act as a template for making the protein.
- The template travels to a ribosome and binds to it.
- The ribosome reads the first three bases in the template. These three bases indicate what the first amino acid in the protein should be. A carrier molecule then brings this amino acid to the ribosome.
- The ribosome reads the next three bases, which indicate what the second amino acid should be. A carrier molecule then brings this amino acid to the ribosome. The second amino acid binds to the first amino acid.
- The template moves through the ribosome. The ribosome reads each set of three bases, and each time a carrier molecule brings the correct amino acid, which then binds to the previous amino acid. This results in a chain of amino acids forming.
- Once the whole template has been read, the chain of amino acids is complete. The chain of amino acids leaves the ribosome and folds up to form the protein.

Why is the shape of a protein important?
Each protein has a unique shape. This shape enables it to carry out its role. For example, the unique shape of an enzyme allows it to catalyse its reaction.

What is non-coding DNA?
Non-coding DNA is the DNA between genes. It does not code for proteins. It often has a role in switching genes on and off - in other words, it controls whether genes are expressed.

What is a mutation?
A mutation is when a DNA sequence changes. Mutations happen frequently in all organisms. Most mutations do not have any effect or only cause slight changes to the proteins formed. Sometimes mutations cause significant changes to proteins.

How could a mutation affect the structure and behaviour of a protein?
If a mutation takes place within a gene, then the gene will have a different base sequence. This could result in the protein that the gene codes for having a different amino acid sequence, which could result in the protein folding up into a different shape and behaving differently. For example, if the protein is an enzyme, its active site may no longer fit the substrate.

How could a mutation affect how much a protein is produced?
If a mutation occurs in non-coding DNA, it could cause changes to the expression of genes that are controlled by that non-coding DNA. If the non-coding DNA was previously switching a gene off, it might now switch the gene on. Or if the non-coding DNA was previously switching a gene on, it might now switch the gene off. Therefore, a mutation in non-coding DNA could affect how much of a particular protein is produced.

How do differences in DNA sequences between individuals cause them to have different characteristics?
Differences in DNA sequences between individuals cause them to have different characteristics in two ways:

- Differences in coding DNA can result in differences in the activity of a protein.
- Differences in non-coding DNA can result in differences in the way that genes are expressed.